Undergraduate Catalog of Courses

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Mathematics and Computer Science

Saint Mary's College of California

MATHEMATICS AND COMPUTER SCIENCE

Mathematics is a liberal art fundamental to a true education. It trains students in analytical thinking, and courses are offered with application to the natural and social sciences. Graduates of the department are active in an extraordinarily wide range of careers. The department offers a science degree in mathematics with a pure applied and computer science track.

A minor in mathematics is available.

FACULTY
Chris Jones, Ph.D., *Professor, Chair*
Kristen Beck, Ph.D., *Assistant Professor*
Andrew Connor, Ph.D., *Assistant Professor*
Charles R. Hamaker, Ph.D., *Professor*
Brother Brendan Kneale, FSC, M.A., M.S., *Associate Professor Emeritus*
Lidia R. Luquet, Ph.D., *Professor Emerita*
Michael Nathanson, Ph.D., *Associate Professor*
Weiwei Pan, Ph.D., *Assistant Professor*
Brother Raphael Patton, FSC, Ph.D., *Professor Emeritus*
Kathryn F. Porter, Ph.D., *Professor*
Jane R. Sangwine-Yager, Ph.D., *Professor Emerita*
Jim Sauerberg, Ph.D., *Professor*
Ellen Veomett, Ph.D., *Associate Professor*

LEARNING OUTCOMES
When they have completed a mathematics major, students will be able to:

- DEMONSTRATE a mastery of the core SMC undergraduate mathematics curriculum.
- COMMUNICATE mathematical ideas and concepts correctly and clearly in both oral and written forms using mathematical reasoning and terminology and symbolic representation.
- UNDERTAKE scholarly investigations using appropriate mathematical resources.
- INTEGRATE the use of technological tools into their investigations.
- DEMONSTRATE knowledge of connections within mathematics and applications to other fields.

MAJOR REQUIREMENTS

A student wishing to major in mathematics should have a strong interest in the field and normally a background of four years of high school mathematics (two years of algebra, one year of geometry and one year of pre-calculus or equivalent). Students fulfill the Area B mathematics requirement of the pre-2012 general education requirements with the courses required for the major or minor.

The Department of Mathematics and Computer Science offers three tracks within the mathematics major. There is a Pure, an Applied and a Computer Science track and all tracks are Bachelor of Science degrees.

LOWER DIVISION
The following lower-division classes are required for all tracks in the mathematics major.
Math 27, 38, 39, Computer Science 21

Plus either **Physics 1-4** OR **Chemistry 8-11**

PURE TRACK
The pure track is designed for students considering graduate study in mathematics or secondary mathematics teaching.

Required upper division courses
Math 103, 111, 120, 150 and **193**

Plus two additional courses from
Math 115, 131 and **183**

Plus three upper division mathematics courses (excluding **Math 101**)

APPLIED TRACK
The applied track is designed for students planning on entering industry directly from college.

Required upper division courses
Math 103, 120, and **193**

Plus one additional course from
Math 111 or **150**

Plus three additional courses from
Math 113, 114, 134 and **CS 102**

Plus two upper division electives at most one of which is a CS course (excluding **Math 101**)

COMPUTER SCIENCE TRACK
The Computer Science track is designed for students interested in an emphasis in Computer Science.

Required upper division courses
Math 103, 120, 140 and **193** and **CS 102**

Plus one additional course from
Math 111 or **150**

Plus three additional courses from
Math 113, 114, 134 and **CS 102**

Plus two upper division electives at least two of which are CS courses (excluding **Math 101**)

SUGGESTED FOUR-YEAR PROGRAM

A suggested four-year program of study for a major in mathematics is available from any department member. First-year students should take **Math 27** and **38** and **CS 21.** Failure to take these courses in the first year may make it impossible to complete the major in four years. Students wishing to concentrate in computer science should take both **CS 21** and **102** in the first or second year. It is also recommended for students to enroll in **Physics 1, 2, 3, 4** or **Chemistry 8, 9, 10, 11** in the first year.

MINOR REQUIREMENTS

The minor in mathematics requires **Math 27, 28** or **38, Math 103** (**Math 39** and/or **Math 120** are recommended), and two more upper-division courses in mathematics, excluding **Math 101.**

SECONDARY TEACHING

All students in California planning to enroll in a teaching credential program in mathematics after earning their undergraduate degree are required to demonstrate subject matter competency in mathematics prior to admission to a credential program. Students at Saint Mary's College exhibit this competency by taking and passing the CSET (California Subject Exam for Teachers) in mathematics. Students interested in becoming a secondary mathematics teacher are advised to complete the following upper-division courses to prepare for the CSET while fulfilling the mathematics major. **Math 103, 111, 113, 115, 120, 131, 150, 193.**

The California Commission on Teacher Credentialing (CCTC) also requires students to obtain "pre-professional field experience" before entering a credential program. This requirement is satisfied by the course **EDUC 122: Field Experience**, offered in the January Term at SMC. Students are required to contact the School of Education in September of their sophomore or junior year to meet with the faculty member teaching **EDUC 122.** Students should also speak with a representative of the School of Education to learn of any other requirements of the state of California for prospective secondary teachers.

COURSES

PREREQUISITE GRADE

Any course listed in this department with a prerequisite requires a grade of C– or better in the prerequisite course, including the high school courses algebra I, geometry and algebra II which are prerequisites of all mathematics and computer science courses except **Math 2** *and* **12.**

LOWER DIVISION

1 Fundamental Mathematical Concepts I

This course provides prospective elementary teachers with part of the background needed for teaching the content of contemporary elementary mathematics programs. The topics include problem solving, the historical development of major mathematical concepts, sets and functions, rational and irrational numbers and their operations, and number theory. Prerequisites: One year each of high school algebra I, II and geometry or equivalent, and a passing score on the placement exam. *Does not satisfy the Area B mathematics requirement of the pre-2012 general education requirements. Offered every fall.*

2 Mathematics Readiness

This course covers basic algebra and geometry concepts including number systems, polynomials, solving equations and inequalities, graphs, functions, lines, systems of equations, sets and operations, ratios, proportions, measurement and percents. Emphasis will be placed on problem solving, critical thinking and mathematical reasoning. *Prerequisites: One year each of high school algebra I and geometry. Students who have also completed algebra II with a C– or better should take the Placement Exam before taking this course. Does not satisfy the Area B mathematics requirement of the pre-2012 general education requirements. Offered every semester.*

3 Finite Mathematics

Topics and applications in this course are selected from linear equations and matrices, linear programming, probability, finance, Markov chains, game theory and graphs. The emphasis is on applications to business and management sciences. *Prerequisites: One year each of high school algebra I, II and geometry or equivalent and a passing score on the placement exam. Seniors are not permitted to enroll in this course. Offered every semester. This course satisfies the Mathematical Understanding requirement of the Core Curriculum.*

4 Introduction to Probability and Statistics

This course covers the study of combinations and permutations, descriptive and inferential statistics, probability and probability distributions, hypothesis testing, regression and correlation, along with applications in a variety of practical settings. This course may not be taken for credit in addition to **Business Administration 40** or **Psychology 3.** *Prerequisites: One year each of high school algebra I, II and geometry or equivalent, and a passing score on the placement exam. Offered every semester. This course satisfies the Mathematical Understanding requirement of the Core Curriculum.*

10 The Art and Practice of Mathematics
A reflective examination of basic mathematical ideas and patterns. Through participation in the discovery and development of mathematical ideas the student will view the subject as a vehicle for human creativity. The course traces the historical and contemporary role of appropriate mathematical topics. *Prerequisites: One year each of high school algebra I, II and geometry;* **English 5** *and* **Collegiate Seminar 1.** *Offered every semester. This course satisfies the Mathematical Understanding requirement of the Core Curriculum.*

12 Mathematics Readiness for Calculus
This course includes the basic study of number systems, linear equations and inequalities, quadratic equations and inequalities, polynomials, rational expressions, radicals, exponentials, functions, inverse functions, logarithmic and exponential functions, angles, triangles, surface area, volume and applications. Emphasis will be placed on problem solving, critical thinking and mathematical reasoning. *Prerequisites: One year each of high school algebra I and geometry. Students who have also completed algebra II with a C– or better should take the placement exam before taking this course. Does not satisfy the Area B mathematics requirement of the pre-2012 general education requirements. Offered in the fall.*

13–14 Calculus with Elementary Functions I, II
A survey of polynomial, trigonometric, logarithmic and exponential functions combined with differential calculus of functions of one variable and mathematical reasoning. This calculus sequence is intended for students who need to strengthen their precalculus skills. The sequence **Math 13–14** is equivalent to **Math 27.** Prerequisites: for **Math 13:** one year each of high school algebra I, II and geometry or equivalent and a passing score on the placement exam. **Math 13** or equivalent is prerequisite to **Math 14. Math 13** *alone does not satisfy the Area B mathematics requirement of the pre-2012 general education requirements. Offered every semester. This course satisfies the Mathematical Understanding requirement of the Core Curriculum.*

27 Calculus I
Limits, continuity, mathematical induction, mathematical reasoning, the derivative, applications of the derivative, antiderivatives and the integral. *Prerequisites: one year each of high school algebra I, II and geometry, Precalculus, or equivalent, and a passing score on the placement exam. Offered every semester. This course satisfies the Mathematical Understanding requirement of the Core Curriculum.*

28 Calculus II with Applications
This course is designed for students majoring in the life sciences, health sciences, business administration, psychology and accounting. Topics include techniques and applications of integration, first order differential equations, functions of several variables, double integrals and applications. *Prerequisite:* **Math 27** *or equivalent. Offered every semester.*

38 Calculus II
This course is designed for mathematics, physics, computer science, engineering and chemistry majors. Topics include techniques and applications of integration, infinite sequences and series, power series, polar coordinates and inverse trigonometric functions. *Prerequisite:* **Math 27** *or equivalent. Offered every spring.*

39 Calculus III
A rigorous treatment of limits for functions of one and several variables, differentiation and integration of functions of several variables, coordinate systems, vectors, line and surface integrals, Green's, Stokes' and the divergence theorems. *Prerequisites:* **Math 38** *or equivalent. Offered every fall.*

UPPER DIVISION
Math 101, 120, 134 and **193** are offered annually. Most of the other upper-division courses are offered on a biannual rotation. Contact the department chair for the schedule.

101 Fundamental Mathematical Concepts II
This course is a continuation of **Math 1** and focuses on geometry and measurement, patterns, probability and descriptive statistics. *Prerequisites: One year each of high school algebra I, II and geometry or equivalent;* **Math 1** *or* **27** *or equivalent. Does not satisfy the Area B mathematics requirement of the pre-2012 general education requirements. This course satisfies the Mathematical Understanding requirement of the Core Curriculum.*

103 Intro. to Upper Division Mathematics
This course is an introduction to mathematical logic and proofs and includes an introduction to Abstract Algebra. Students will learn to write proofs using standard proof-writing organization and terminology. Topics from algebra will include the division algorithm, modular arithmetic, rings and groups. *Prerequisistes:* **English 5** *and* **Math 38,** *or equivalent. Completion of* **Math 103** *and* **Math 193** *satisfies the Writing in the Disciplines requirement of the Core Curriculum.*

111 Abstract Algebra I
Topics covered include Modules, vector spaces, fields and Galois theory. *Prerequisites:* **Math 103** *and* **120** *or permission of instructor.*

113 Probability and Statistics
Discrete and continuous random variables, expectation and variance, independence, distributions and the Central Limit Theorem. Survey of statistical methods: estimation, sampling, hypothesis testing, linear regression and confidence intervals. *Prerequisites:* **Math 28** *or* **38,** *or equivalent.*

114 Mathematical Modeling
An introduction to the formulation, analysis and interpretation of results of mathematical models in the study of real-life problems chosen from the various areas of natural sciences, social sciences, economics and business. *Prerequisites:* **Math 28** *or* **38**, *or equivalent, and* **CS 21.**

115 Number Theory
Results studied include the Fundamental Theorem of Arithmetic, the Euclidean algorithm, Fermat's Little Theorem and Euler's generalization, Diophantine equations and the Law of Quadratic Reciprocity. *Prerequisites:* **Math 103** *or permission of instructor.*

120 Linear Algebra with Applications
Matrices, simultaneous linear equations, linear transformations, vector spaces, bases, determinants, eigenvectors, Gram-Schmidt orthonormalization, techniques of mathematical proof and applications of linear algebra. *Prerequisites:* **Math 28** *or* **38** *or equivalent.*

131 Topology
This course covers the fundamentals of point-set topology including topological spaces, metric spaces, continuous maps, separation axioms, connectedness, and compactness. *Prerequisite:* **Math 103** *or permission of instructor.*

134 Differential Equations
Ordinary differential equations, existence and uniqueness theorems, some numerical methods, Laplace transforms, series solutions, linear systems with constant coefficients, partial differential equations, separation of variables, Fourier series *Prerequisites:* **Math 39,** *or* **Math 38** *and* **Math 120,** *or equivalent.*

140 Combinatorics and Discrete Mathematics
This course focuses on discrete structures and their relations. Topics may include counting techniques, relations, graph theory and logic. *Prerequisites: Any one of these pairs:* **Math 28** *or* **38** *or equivalent.*

150 Advanced Calculus
A rigorous review of the theory of single variable calculus, topology of n-space, integration and differentiation, improper integrals, differential forms, the theorems of Stokes and Gauss. *Prerequisites:* **Math 39** *and* **Math 103,** *or permission of instructor.*

185 Complex Variables
Differentiation and integration of analytic functions of a complex variable, power series, residues, conformal mappings. *Prerequisites:* **Math 39** *and* **Math 103,** *or permission of instructor.*

190 Special Topics in Mathematics
An upper division mathematics course not listed above, such as differential geometry, numerical analysis, topology or real analysis. May be repeated for credit as topics vary. *Prerequisites: vary with topics.*

193 Senior Seminar
An in-depth critical examination of a topic or topics in contemporary mathematics. The course consists of directed reading, presentations, research and the writing of a final essay under the supervision of the instructor. At the conclusion of the semester students are expected to present their work at a departmental colloquium of faculty and students. The essay is evaluated by a committee consisting of the faculty supervisor and two other faculty chosen in consultation with the student. *Prerequisites:* **Math 103** *or consent of instructor. Senior or second-semester junior standing required. Completion of* **Math 103** *and* **Math 193** *satisfies the Writing in the Disciplines requirement of the Core Curriculum.*

197 Special Study
Independent research of topics not covered in listed courses. *Permission of the chair is required.*

199 Special Study — Honors
Independent study or research for majors with at least a B average in mathematics. *Permission of the chair is required.*

COMPUTER SCIENCE

The courses in computer science emphasize fundamental principles and computer structure. They introduce students to the design and applications of computer systems, and prepare students to use computers as tools in solving complex problems. For 3+2 Computer Science, see 3+2 Engineering Program.

PREREQUISITE GRADES

Any course listed in this department with a prerequisite assumes a grade of C– or better in the prerequisite course, including the high school courses algebra I, geometry and algebra II, which are prerequisites of all mathematics and computer science courses. Students who have not satisfied the high school prerequisites will be required to successfully complete a special mathematics readiness course before taking any course that will satisfy the Area B mathematics requirement of the pre-2012 general education requirements.

COURSES

LOWER DIVISION

21 Programming

An introduction to problem-solving concepts and program design. Topics covered include top-down design with a structured programming language, bottom-up testing, control statements and structured data types. No prior knowledge of programming is required. The language for the course is Python or C++; students with knowledge of another programming language will find the course valuable. Prerequisites: one year each of high school algebra I, II and geometry or equivalent, and a passing score on the placement exam. *Offered each spring.*

UPPER DIVISION

Consult the department chair for the schedule of offerings.

102 Advanced Programming

A continuation of **Computer Science 21.** Topics include recursion, an introduction to data structures, analysis of algorithms and object-oriented programming. Programming style and large program development are emphasized. *Prerequisites:* **Computer Science 21** *or an equivalent C++ based course.*

110 Computer Systems

Computer structure and machine languages, assembly language macros, file I/O, program linkage and segmentation. *Prerequisites:* **Computer Science 102** *or equivalent.*

174 Analysis of Algorithms

Basic notions of the design and efficiency of computer algorithms, nonnumerical algorithms for sorting and searching and numerical algorithms. Underlying data structures are examined. *Prerequisites:* **Computer Science 102** *and* **Math 28** *or equivalent.*

190 Topics in Computer Science

This course presents connections among different disciplines which apply the principles of computer science. The theme varies. Students are required to complete a significant project involving their primary discipline. *Prerequisites: varies with topic.*

197 Special Study

Independent study in topics not covered in listed courses. *Permission of the department chair is required.*